The Ω_b Baryon at D0

Based on a 1.3 fb^{-1} sample of Tevatron Run IIa data, the D0 Collaboration published the observation of the doubly-strange b baryon, Ω_b^- in the $J/\psi\ \Omega^-$ channel [1]. The measured Ω_b^- mass disagreed significantly with that subsequently observed by CDF [2] and LHCb [3]. The observed D0 mass for the Ξ_b^- baryon [4] in the topologically identical $J/\psi\ \Xi^-$ channel does agree with those measured by CDF and LHCb.

A variety of tests and cross-checks were made, and none indicated a flaw in the Run IIa analysis. However, after applying the additional Wilks theorem factor [5] and the look elsewhere effect [6] which were not used in the published analysis, the global p-value [7] was calculated to be 6×10^{-6}, which corresponds to a statistical significance of 4.4σ (instead of the published 5.4σ) for the Run IIa peak [1].

Several attempts to reproduce the Run IIa signal in the additional 9.1 fb^{-1} of the Tevatron Run IIb data were made and no significant indication of any peak in the $J/\psi\ \Omega^-$ channel was observed. However, our studies indicate that detection of such a signal in the Run IIb data would have been challenging due to the substantially higher instantaneous luminosity in that data set.

The re-evaluated lower statistical significance of the Ω_b signal, and the mass disagreement of the 2008 result with other experiments, lead us to conclude that the 2008 result was likely not due to the presence of an Ω_b signal but rather due to a background fluctuation and/or other unidentified effects, and thus should be disregarded as an observation of the Ω_b baryon.

[1] V.M. Abazov *et al.* (D0 Collaboration), Phys. Rev. Letters **101**, 232002 (2008).

[2] T. Aaltonen *et al.* (CDF Collaboration), Phys. Rev. D **80**, 072003 (2009); T. Aaltonen *et al.* (CDF Collaboration), Phys. Rev. D **89**, 072014 (2014).

[3] R. Aaij *et al.* (LHCb Collaboration), Phys. Rev. Letters **110**, 182001 (2013).

[4] V.M. Abazov *et al.* (D0 Collaboration), Phys. Rev. Letters **99**, 052001 (2007).

[5] S. S. Wilks, *"The Large-Sample Distribution of the Likelihood Ratio for Testing Composite Hypotheses"*, The Annals of Mathematical Statistics **9**, 60, (1938). We now account for 2 degrees of freedom (position of peak, magnitude of peak) to derive the p-value, while Reference [1] accounted for 1 degree only.

[6] E. Gross and O. Vitells, *"Trial factors for the look elsewhere effect in high energy physics"*, Eur. Phys. J. C **70**, 525 (2010).

[7] The global p-value is the probability that an equivalent sample of data without the signal would fluctuate in such a way to produce an apparent signal of equivalent or greater significance than that observed over the data range investigated.